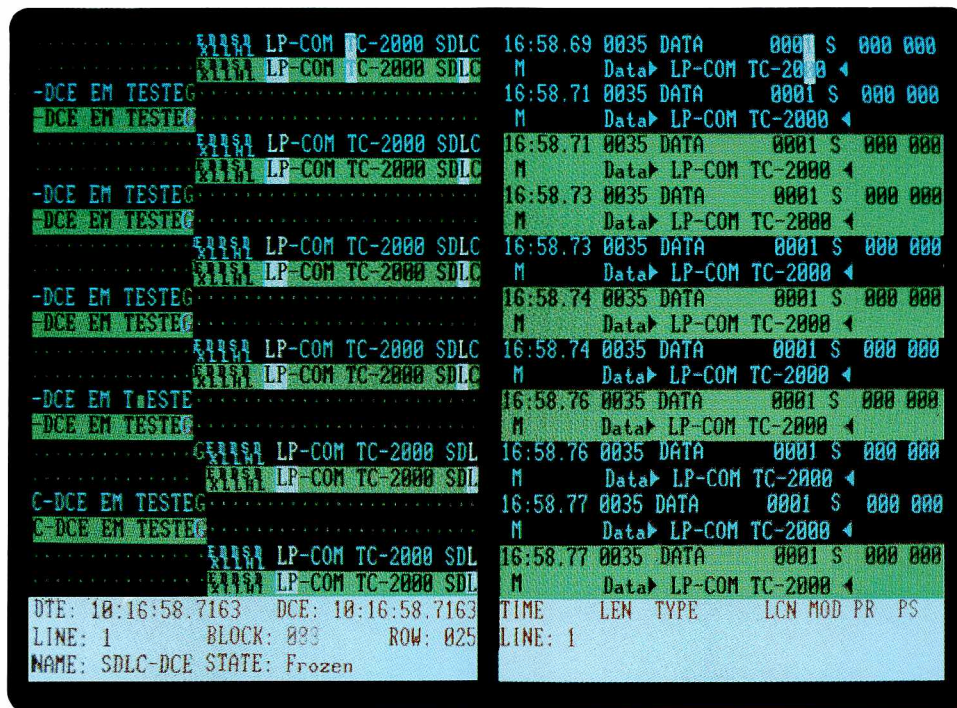


Your protocol analyzer can't do this.



Shown is LP COM's optional color display



But LP COM's can.

Compare. No other protocol analyzer does the work of the TC-2000. Look at the screen. It's the first protocol analyzer with full duplex dual port operation. It's like having two separate analyzers testing simultaneously.

Split screen capability also lets you display two modes of operation for the same line simultaneously.

With the TC-2000's unique time/date stamping—right down to character level at a full 64 KBS—you can isolate problems exactly when they occur. And the TC-2000 real-time lead state display is also unique.

This is the most powerful protocol analyzer available. With virtually unlimited trap/trigger capability, you can use the full-featured emulation mode to

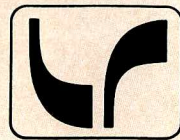
provide simulation of the most complex networks.

Installation, troubleshooting, and performance monitoring of telecommunications systems have never been easier.

And that's only the beginning. As a multi-function system, the TC-2000 has no equal. Powerful options for the most versatile protocol analyzer available include • The industry's best *TIMS* analog measurement module. • A full featured *signaling* test capability. • Comprehensive *automatic trunk testing*. • *PCM/DS-1* testing that ties PCM into the TC-2000's other measurement capabilities. • *IBM® PC/XT compatibility*.

For the rest of the story about the system that has redefined the future of network testing, ask for our detailed data package. Please address LP COM, 205 Ravendale Drive, Mountain View, CA 94043. Phone (415) 967-5400.





LP COM

TC-2000
TELECOMMUNICATIONS
TEST SYSTEM



The dawn of future testing technology

The LP COM TC-2000 Redefines

TODAY'S CHALLENGE

Testing a network is a big job that's getting bigger every day.

Today's communications manager faces tough challenges:

- To keep pace with rapidly advancing technology;
- To test complex networks in a multi-vendor environment;
- To provide 98% or more system uptime;
- To increase field service efficiency;
- To lower costs while providing more powerful test capabilities;

for the networks of today *and* tomorrow.

That's why LP COM developed the TC-2000, the most advanced answer to those challenges available today. Or tomorrow.

REVOLUTIONARY SOLUTIONS

LP COM was formed in 1983. The years since that founding have brought divestiture and deregulation of the industry, resulting in vast changes in the way communications circuits and services are provided. LP COM's goal was to develop the first truly integrated network testing solution for both providers and users of communications circuits.

The result? The revolutionary LP COM TC-2000, destined to be the future of network testing.



the future of Network Testing:

Consider these features, provided for the first time ever in one compact unit:

- Advanced Data Protocol Analysis;
- Powerful PCM/BERT test capability;
- Full TMS testing;
- Automated Trunk Testing;
- Complete Signaling/Supervision testing;
- Full portability;
- Powerful *user-defined* automatic test sequences;
- Full remote control operation;
- Totally compatible IBM-PC computing capability that runs virtually any IBM-PC software.

The TC-2000's power and versatility can be configured to combine any or all of these functions in one extremely user friendly package. And, if your test needs don't require all of these functions today, you can easily include only the test options you need now and add the others later—very economically.

MORE FOR LESS

Despite its modest size, the TC-2000 literally outperforms and replaces up to eight separate test systems, shrinking over 250 pounds of conventional tester capability into one fully portable 40-pound unit (also available rack-mounted).

It's true. Major advances in Digital Signal Processing (DSP) combine with an extraordinary amount of computing power, resulting in added capabilities and amazing ease of use. At a fraction of the weight. A fraction of the cost. The LP COM TC-2000. Incredible power. Incredible simplicity.

SOFTWARE MAKES THE DIFFERENCE

LP COM's advanced software and breakthroughs in DSP are the keys to the TC-2000's treasury of integrated test functions and efficiency. Simple menus allow users to master various test functions with incredible speed.

A ruggedized 10 megabyte hard disk holds the LP COM software and provides megabytes of storage for your use. You get the latest technology with virtually no chance of hardware obsolescence, and no need to worry about manual loading and reloading of test routines.

Tests are available at the stroke of a key, making the TC-2000 extremely user friendly. It offers:

- Elimination of learning a complicated programming language;
- Prompts and display menus that guide even inexperienced users through test set-ups, saving time and money;
- The ability to run tests manually or use powerful automatic test sequences, run in any order the user desires;
- Computer memory capacity for storing large amounts of data and test set-ups for later use.

POWERFUL FIRSTS FOR TC-2000

LP COM has packed extraordinary power into the TC-2000, bringing you capabilities other firms haven't approached. With the TC-2000, the future of network testing is redefined.

TOTAL NETWORK TESTING:

The TC-2000 can include *all* of the following test functions.

PROTOCOL ANALYZER

The TC-2000's Protocol Analyzer is uniquely configured to satisfy the needs of both large and small communication data network centers. It supports all character and bit-oriented protocols up to 64 Kbps, making installation, troubleshooting and performance monitoring of telecommunications systems surprisingly easy. Major features include:

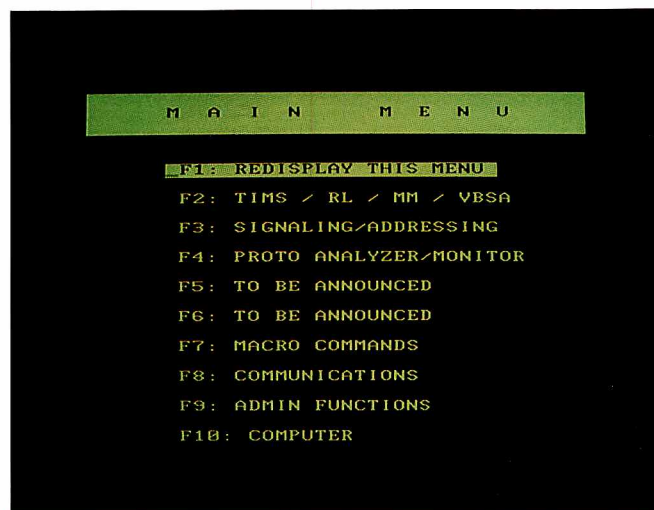
- The first protocol analyzer with full duplex dual port operation—like having two separate analyzers testing simultaneously;
- Split-screen capability—two modes of operation displayed simultaneously;
- User-friendly menus simplify performance of numerous tasks at the physical, data link and network protocol levels;
- Powerful, full-featured emulation mode to allow simulation of the most complex networks;
- Unique time/date stamping capability on a frame, packet or character basis—isolates problems exactly when they occur;
- Prints hard copies of all stored information.

The TC-2000's Protocol Analyzer is also very flexible. A dial-up line brings a complete remote capability into play, permitting transfer of data, set-ups and user programs—plus the ability to run a slave unit from a master location.

TIMS LIKE NO OTHER

Fully compatible with existing TIMS measurement devices, the LP COM TC-2000's TIMS offers important new capabilities as well. Its response times are much faster than those of existing equipment, and it includes several other industry "firsts":

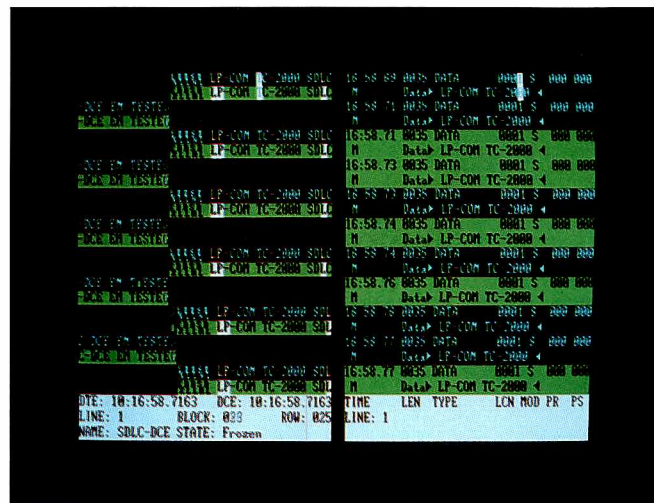
- Full DSP TIMS instrument requires little or no calibration, yet provides reliable, accurate measurements;
- Powerful plotting capabilities with user definable sweep limits and rates, adjustable x-y limits (allows delay or response curve expansion) and hard copy printouts;
- Data save mode for all test results and set-up information combined with a notepad and calculator;
- Self programming automatic test sequences with user-defined parameters;
- Can be remotely controlled by another TC-2000, or by a properly equipped IBM PC (or equivalent);
- Offers both two-wire and four-wire measurements in all TIMS measurements.



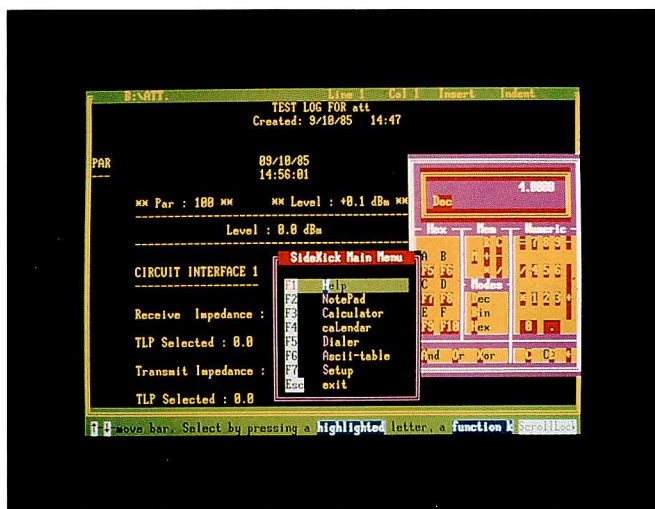
TC-2000 Main Instrument Selection Menu



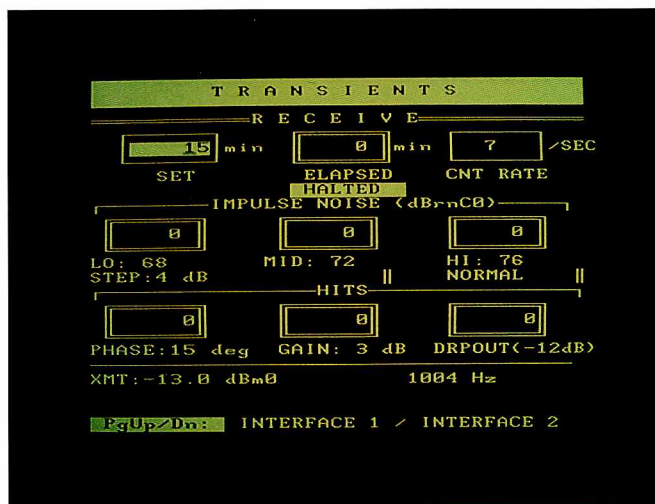
PROTOCOL—Main set-up menu with auto configuration.



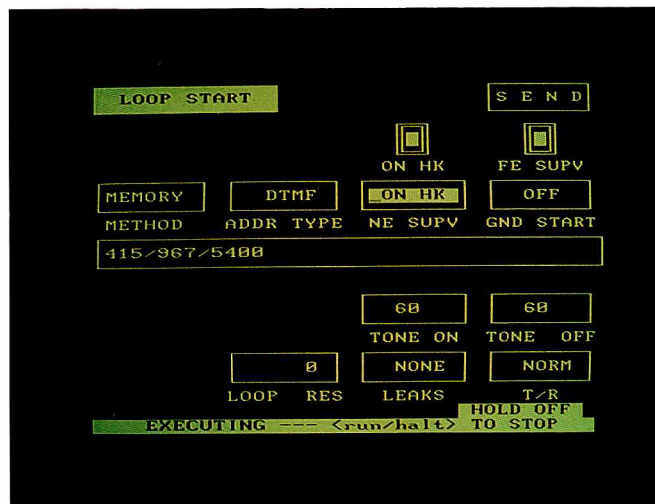
PROTOCOL—Split screen, dual display, with time stamping and X.25 analysis.



ADMINISTRATION—Logged data in notepad mode with results and set-up information, date and time stamped, with calculator displayed.



TIMS—Transient tests, all impairments measured simultaneously with elapsed time.



SIGNALING—Loop start DTMF send mode with supervision indicators.

VOICE BAND SPECTRUM ANALYZER

First truly inexpensive voice band spectrum analyzer to provide real-time display of both level and spectrum. This option combined with the TC-2000 TIMS capabilities now provide the user with all the tools necessary to troubleshoot those analog network problems. Features include:

- Full plotting capabilities including continuous sweep, adjustable sweep limits and rates, and adjustable x-y limits;
- Data save mode for hard copy printouts;
- 70 dB dynamic range.

AUTOMATIC TRUNK TESTING

This TC-2000 option provides automatic trunk testing of telecommunications networks by using a TC-2000 in conjunction with LP COM's Trunk Interrogator. Average test time is less than one minute per trunk, providing a weekly test throughput of thousands of trunks. TC-2000 trunk testing can be done in an unmanned mode (such as low-traffic period testing), or upon user demand. Test results are stored on hard disk, and can be printed out whenever desired. Other major features include:

- Cost-effective testing of smaller networks of under 1,000 trunks, but with the capacity to handle networks as large as 10,000 trunks and 1,000 trunk groups;
- Fully compatible with Bell/AT&T CAROT and ROTL technology, as well as 3M's APC products;
- Interfaces with remote PABX's;
- Full 105 Farend Responder capabilities, as well as complete Nearend Responder functionality;
- Both automatic and manual CAROT controller capability.

SIGNALING

The TC-2000 also brings a few "firsts" to Signaling testing. It is the first full signaling test set to incorporate all test modes of operation. Its' 32 digit display permits the user to view received DTMF and MF tones. The telephone craftsman can monitor the trunk via a built-in loudspeaker, or can actually communicate on the trunk being tested with a standard telephone headset. Circuits can be accessed, held, and then tested utilizing the other TC-2000 test functions (TIMS, Protocol, etc.). This is real versatility.

PCM

LP COM is committed to continuing advances in testing technology. Coming in late 1986 is technology that will permit—for the first time—the ability to look at a PCM channel on an analog, digital and data basis with the same instrument. The TC-2000 will provide the capability to perform dual drop and insert, at DS0 and sub-rates, permitting the user to direct the channel to other instrument functions within the TC, such as TIMS or Protocol.

IBM-PC COMPATIBLE

When it's not being used as a testing device, the TC-2000 can be used as a workstation! It has all the standard features of an IBM-PC/XT, and features built in self-diagnostics. It runs MS-DOS software, and is the first test system to permit a user to output plots of data on an inexpensive printer instead of an expensive X-Y plotter or strip chart recorder.

And, LP COM makes everything easy, providing a resident Tutorial which is simply accessed by pressing the "Help" key, in addition to a conventional manual.

Incredible Power. Incredible Simplicity.

A NEW STANDARD IN EFFICIENT FIELD USE

LP COM has built the TC-2000 to be fully portable, yet there's a complete product line in every unit. It's actually eight test instruments in one.

The menu driven system is easy to learn and easy to use, and saves time in the field by reducing reliance on the instruction manual. Because it has full remote capability, the TC-2000 operates in a MASTER/SLAVE mode without needing a complicated communications language. Test sequences are simple to run, and our software-based design permits easy updating by eliminating major hardware retrofits.

The TC-2000—It saves time and money all the way down the line.

LP COM—RELIABLE AND CREDIBLE

The LP COM team has decades of experience in telecommunications test systems, and is committed to providing the best network test system.

Through leadership in technology, LP COM has dramatically reduced the amount of test hardware required, resulting in less than 20% of the parts count of conventional equipment. That means fewer things can go wrong, and less calibration, resulting in a major cost advantage to you.

Each TC-2000 has a full one year warranty. That's four times longer than our largest competitor offers. Because our designs undergo extensive shock and vibration testing, plus 96 hours of high-temperature burn-in on all of our units, you get true dependability from LP COM.

And, you can custom build your system as needs and budget permit with incredible cost efficiency. By combining the latest test technology with great computing power, LP COM lets you add new features with a new diskette or plug-in module.

With the TC-2000, you'll have a test system that *won't* be obsolete two or three years from now—it can grow with the changing technology and changing needs.

POWERFUL. SIMPLE. COST EFFECTIVE.

That's the LP COM TC-2000. An investment that will *stay* at the leading edge of technology. . . and, meet all of tomorrow's challenges.

HOW DID THEY DO IT?

A natural question is to ask how LP COM has managed to package 250 pounds of testing capability into a 40-pound portable unit. Have capabilities been left out, or performance compromised? The answer is an emphatic no—thanks to major advances by LP COM in digital signal processing (DSP), combined with an unusual amount of computing power.

LP COM R&D efforts have resulted in multiple patents pending regarding our advances in DSP. To implement this massive use of DSP, a fully-equipped LP COM TC-2000 has over *twenty times* the numeric processing power of an IBM PC. These factors have allowed LP COM to reduce the size of the electronic circuitry required by 80%, while actually *adding* functionality.

But all of this advanced LP COM technology results in just a few basic benefits: more capability at a fraction of the size and cost, and with major improvements in ease of use. Ask us for a demonstration.



GENERAL SPECIFICATIONS

The LP COM TC-2000 provides the user with the most powerful integrated telecommunications testing capabilities available. Various network testing problems such as signaling/supervision, analog parameters (TMS), data protocol analysis, and administrative applications, can now be solved by a single, very powerful portable test unit. The TC-2000's versatility allows the user to combine any or all these required test functions into a single package. The TC-2000, with its IBM PC compatibility and communications package, allows powerful remote testing—either TC-to-TC, or TC-to-IBM PC-compatible computer. Automatic test sequences can be easily programmed and run by the TC-2000.

TC-2000 MAJOR COMPONENTS

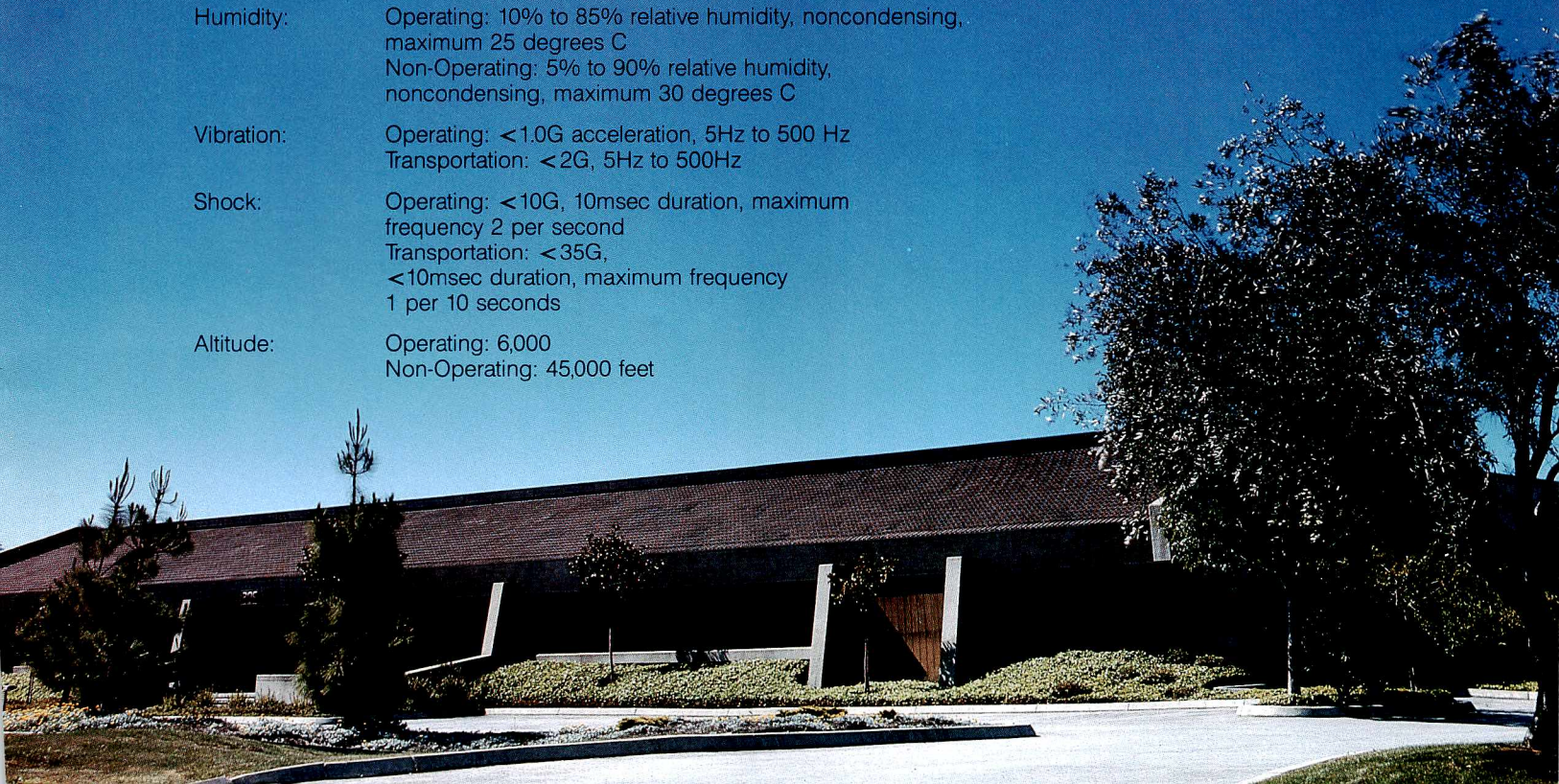
CRT:	7" diagonal, high-resolution graphics 640 pixel horizontal by 400 pixel vertical resolution—graphics mode.
Disk Drives:	1 each 10MB ruggedized Hard Disk, 1 each 5¼" 360KB floppy-disk
Keyboard:	83 keys and legends corresponding to instrument functions.
I/O Ports:	External Video: 9-pin D Connector, RGB 26MHz bandwidth, composite video. Printer Interface: 25-Pin D Connector, IBM-compatible parallel interface. RS-232 computer serial port, IBM-PC compatible configuration. Others dependent upon options installed.
Processors:	Intel 8086 (2 each), 8087 (1 each), 8088 (1 each), and 80286 (2 each with protocol option), Texas Instruments TMS320 (2 each)
Memory:	640KB RAM

PHYSICAL

Power:	Input 115V/230 AC $\pm 10\%$, 48-66 Hz, 230 Watts max.
Weight:	35 to 40 pounds (depending on options installed)
Size:	8" High, 17" Wide, 19" Deep including Keyboard

ENVIRONMENTAL LIMITS

Temperature:	Operating: 10 degrees to 40 degrees C Non-operating: -35 degrees to 65 degrees C
Warm-Up Time:	Max. Rate of Change: 10 degrees C per Hour
Humidity:	Operating: 10% to 85% relative humidity, noncondensing, maximum 25 degrees C Non-Operating: 5% to 90% relative humidity, noncondensing, maximum 30 degrees C
Vibration:	Operating: <1.0G acceleration, 5Hz to 500 Hz Transportation: <2G, 5Hz to 500Hz
Shock:	Operating: <10G, 10msec duration, maximum frequency 2 per second Transportation: <35G, <10msec duration, maximum frequency 1 per 10 seconds
Altitude:	Operating: 6,000 Non-Operating: 45,000 feet



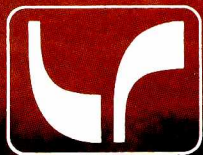
ONLY THE TC-2000 COMBINES THESE FEATURES:

- MODULAR TOTAL NETWORK TESTING (TNT)
 - DATA PROTOCOL
 - TIMS
 - SIGNALLING
 - PCM
 - AUTO TRUNK ROUTINING
- POWERFUL, USER-DEFINED AUTOMATIC TEST SEQUENCES
- UNMANNED-REMOTE TESTING
- IBM PC/XT-COMPATIBLE COMPUTING CAPABILITY
- MORE PERFORMANCE, AT A FRACTION OF THE COST AND SIZE



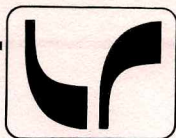
Take the TC-2000 for a spin

Like to see an example of the TC-2000's power and ease of use? If you have access to an IBM PC (or 100% compatible) equipped with the color/graphic adapter and at least 512KB memory, you're in business. Just drop us a line with your business card requesting your free copy of the LP COM Demonstration diskette—we'll send it off to you by return mail.



LP COM

205 Ravendale Dr., Mountain View, CA 94043 • (415) 967-5400
04308610M



LP COM

TC-2000-00

TELECOMMUNICATIONS TEST SYSTEM

FEATURES

- 10 MB HARD DISK
- 640 K RAM MEMORY
- HIGH RESOLUTION CRT
- ADMINISTRATION SOFTWARE
 - CALCULATOR
 - SCRATCH PAD
 - CALENDAR
- MULTIPLE PROCESSORS
- 5 1/4" FLOPPY DISK
- SERIAL/PARALLEL PORTS (PRINTER/RS-232)
- IBM® PC (MS-DOS) COMPATIBLE
- CLOCK/CALENDAR

APPLICATION

The LP COM Telecommunications Test System, Model TC-2000-00, provides the user with the most significant, cost effective family of Telecommunications test capabilities available in the industry today. The TC-2000-00 is more than just an enclosure to house all the significant telecommunications test functions; it is a powerful and versatile IBM PC compatible computer as well.

The LP COM TC-2000 is the answer to today's diverse telecommunications testing requirements. The TC-2000's versatile and powerful architecture allows for the first time the combining of any or all of the following telecommunications functions: Protocol, Transmission Impairment Measurements (analog parameters), Signaling/Supervision, Voice Band Spectrum Analyzer, PCM/T-Carrier, and various Administrative functions, plus the power and capability of an IBM compatible PC into a single compact, portable, extremely user friendly package. This powerful functional capability is made possible in part through the implementation of Digital Signal Processing (DSP). The user can now achieve dramatic improvements in accuracy, reliability, and price, over any conventional analog based techniques.

Even training takes on a new dimension with the TC-2000's interactive Tutorial HELP. Plus, for the first time in the industry a single product provides a common denominator of screen presentations and menu guided operations for all instrument functions.

The TC's standard memory configuration includes a 10MB hard disk, one 5-1/4"/360KB floppy and 640K of RAM. Combine this storage capability with a powerful Administration package, which is also standard, and you have the first set of instruments that not only can save the time/date stamped test results and set-up information, but allows the operator, via a notepad and calculator, to append comments and calculations.

The architecture and computing power of the TC-2000 provides an instrument that can be used easily by entry level technicians and senior communications engineers, alike.

Install the Communications Package option and you now have an extremely cost effective remote testing device—and since the device is IBM PC compatible, the Master Station can either be a TC-2000 or an appropriately configured personal computer.

The TC-2000 is truly in a class by itself—performance, functions, price and size. Whether the application is within a Technical Control Center, Field Service Center, or integrated into complex network switches, the operator is now able to efficiently diagnose and resolve any of a myriad of telecommunications problems. Performance and Capability Unequaled in today's Industry.

SPECIFICATIONS

TC-2000 MAJOR COMPONENTS

CRT	7" diagonal, high-resolution graphics 640 pixel horizontal by 200 pixel vertical resolution— graphics mode 800 pixel horizontal by 400 pixel vertical resolution— text mode
Disk Drives	1 each 10MB ruggedized hard disk, 1 each 5¼" 360KB floppy disk
Keyboard	Detachable, with 83 keys and legends corresponding to instrument functions.
I/O Ports	External Video: 9-pin D Connector, RGB 26MHz bandwidth, composit video. Printer Interface: 25-pin D Connector, IBM compatible parallel interface. RS-232 computer serial port, IBM-PC compatible configuration. Others dependent upon options installed.
Memory	640KB RAM

PHYSICAL

Power	Input 115V/230 AC $\pm 10\%$, 48-66Hz, 230 Watts Max
Weight	35 to 40 pounds (depending on options installed).
Size	8" High, 17" Wide, 19" Deep including Keyboard

ENVIRONMENTAL LIMITS

Temperature	Operating: 10 degrees to 40 degrees C Non-Operating: -35 degrees to 65 degrees C
Warm-Up Time	Max. Rate of Change: 10 degrees C per Hour
Humidity	Operating: 10% to 85% relative humidity, noncondensing, maximum 25 degrees C. Non-Operating: 5% to 90% relative humidity, noncondensing, maximum 30 degrees C.
Vibration	Operating: <1.0G acceleration, 5Hz to 500Hz Transportation: <2G, 5Hz to 500Hz
Shock	Operating: <10G, <10msec duration, maximum frequency 2 per second Transportation: <35G, <10msec duration, maximum frequency 1 per 10 seconds.
Altitude	Operating: 6,000 feet Non-Operating: 45,000 feet

OPTIONS

TC-2000-01	Transmission Impairment Measurements
TC-2000-02	Protocol Analyzer/Monitoring
TC-2000-04	Signaling/Supervision/Addressing
TC-2000-05	Trunk, Manual Interrogator Unit
TC-2000-06	Automatic Trunk Routining Software Package
TC-2000-07	PCM Analyzer
TC-2000-19	RS-449 Interface (Protocol)
TC-2000-21	Voice Band Spectrum Analyzer
TC-2000-24	RS-232 Interface (Protocol)
TC-2000-25	V.35 Interface (Protocol)
TC-2000-26	X.21 Interface (Protocol)
TC-2000-27	Internal Modem, General Communications and Remote Functional Test Software
TC-2000-28	Remote Functional Test Software for IBM PC (or compatible)

Pricing and specifications subject to change without notice.

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LP COM

TC-2000-01

TIMS

FEATURES

- USER DEFINED AUTOMATIC TEST
 - SEQUENCES-MACRO COMMANDS
- LOGGING & DATE/TIME STAMPING OF RESULTS & TEST SET-UP
- POWERFUL ADMINISTRATION MODE
 - NOTEPAD
 - CALCULATOR
 - MS-DOS COMPATIBLE FILES
- SELF-CALIBRATING
- 4 & 2 WIRE OPERATION
- 20HZ TO 110KHZ OPERATION
- PLOTTING CAPABILITY
- ELIMINATES NEED FOR X-Y PLOTTER & STRIP CHART RECORDER
- DIGITAL SIGNAL PROCESSING
- REMEMBERS LAST TEST SET-UP
- FULL COMPLIANCE WITH BELL PUB-41009 AND IEEE-743

APPLICATION

The TC-2000-01 features complete multi-function TIMS capability including P/AR and Return Loss.

The TC-2000-01 acts as both transmitter and receiver of test signals for both four-wire and two-wire lines. Circuit measurement parameters include P/AR, Level Frequency, Envelope Delay, Noise (with and without tone), Phase and Amplitude Jitter, Intermod Distortion, all Transient Parameters, Return Loss plus Monitor and Dial/Hold capabilities. All measurement techniques conform to the Bell System requirements as detailed in PUB-41009 and the IEEE Specification 743. The TC-2000-01 is industry's first TIMS package to totally use the latest state-of-the-art Digital Signal Processing (DSP) technology. Performance has just entered a new dimension.

The truly unique capabilities of the TC-2000-01 are its' Automatic Test Sequences/Macro-Command/Plotting and Data Storage capabilities. Automatic test sequences may be user-defined and stored so that routine tests can be conveniently recalled, performed and automatically logged with minimal operator interaction.

The instrument's easy-to-use prompted menu-driven approach provides an ease of use unmatched in the industry today. Add to this a high resolution graphic display for all your plotting needs—plus user selected circuit limits. Training the entry level technician has just become a much easier and far less costly task.

FOUR-WIRE (4-W) SPECIFICATIONS

TWO-WIRE (2-W) SPECIFICATIONS **

PHASE-AMPLITUDE JITTER SPECIFICATION CONTINUED:

PHASE JITTER:

Measurement Range	0.0 degrees to 45.0 degrees peak to peak	0.0 degrees to 45.0 degrees peak to peak
Accuracy	±0.2 degrees, ±5% of reading	±0.3 degrees, ±5% of reading
Resolution	0.1 degree	0.1 degree

AMPLITUDE JITTER:

Measurement Range	0.0% to 45.0% peak to peak	0.0% to 45.0% peak to peak
Accuracy Range	±0.2% peak to peak; ±5% of reading	±0.3% peak to peak ±5% of reading
Resolution	0.1%	0.1%

RETURN LOSS SPECIFICATION

Measurement Modes	SRL HIGH, SRL LOW, ERL	SRL HIGH, SRL LOW, ERL
Transmit Level Range	-40 to 0dBm -40 to -6dBm @ 135 Ohm	-10 to -6dBm
Measurement Range	0 to 50dB	0 to 50dB
Accuracy	±1dB	±2dB
Resolution	±1dB	±2dB
4W Transhybrid Loss Compensation	-10 to +30dB	N/A
2W Ref Impedance	N/A	600 Ohm or 900 Ohm ±1% in series with 2.16uf ±1% capacitor

TRANSIENT SPECIFICATION

TRANSMITTER:	1004Hz Holding Tone (See L/F for Specs)	1004Hz Holding Tone (See L/F for Specs)
RECEIVER:		
RECEIVER LEVEL	-40 to +10dBm	-40 to +10dBm (Depending on Transmit Level & Transhybrid Loss Correction)
RECEIVER FREQUENCIES	990Hz to 1030Hz	990 to 1030Hz
Filter	C-Notch	C-Notch
Count Rate	7, 8 or 100 per second	7, 8 or 100 per second
Count Range	0 to 9999 counts	0 to 9999 counts
Timer	1 to 9999 minutes in 1 minute increments	1 to 9999 mins. in 1 min. increments
Hit/Dropout Guard	4msec, nominal	4msec, nominal
Interval Counting Hierarchy	Impulse noise counts are interlocked with hit and dropout occurrences in accordance with Bell System/IEEE P743 Specifications	Impulse noise counts are interlocked with hit and dropout occurrences in accordance with Bell System/IEEE P743 Specifications

THRESHOLDS:

Count without tone		
Impulse Noise Range	30 to 110dBm in 1dB steps	30 to 110dBm in 1dB steps
Normal Impulse Noise Range	30 to 110dBm in 1dB steps, limited to holding tone level -30dB/+15dB.	30 to 110dBm in 1dB steps, limited to holding tone level -30dB/+15dB.
Threshold Spread	2, 4, 6, 8 dB	2, 4, 6, 8 dB
Accuracy	±1dB	±2dB
Phase Hit Range	5 degrees to 45 degrees peak in 5 degree steps	5 deg. to 45 deg. peak in 5 deg. steps
Accuracy	±0.5 degrees, ±10.0% of Threshold	±0.5 degrees, ±10.0% of Threshold
Gain Hit Range	1 to 10dB in 1dB steps	1 to 10dB in 1dB steps
Accuracy	±0.5dB	±1.0dB
Dropout	>12db ±1dB decrease in level	>12dB ±1dB decrease in level

**NOTE: For simultaneous transmit or receive operation, use 2-W mode; otherwise ALWAYS use 4-W mode for improved accuracy.

Pricing and specifications subject to change without notice.



LP COM

TC-2000-02

PROTOCOL ANALYZER

FEATURES

- FULL DUAL PORT OPERATION - TWO ANALYZERS IN A SINGLE ENCLOSURE
- TIME STAMPING OF ALL EVENTS ON A PER CHARACTER BASIS
- MULTI-PAGE FREEZE MODE WITH SCROLLING/PAGING CAPABILITY
- DATA RECORDING AT 64KBPS FULL DUPLEX
- POWERFUL OPEN-ENDED SOFTWARE ARCHITECTURE
- AUTOMATIC CONFIGURATION
- AUTOMATIC CONFIGURATION
- SPLIT SCREEN FOR EITHER SINGLE OR DUAL LINE APPLICATIONS
- INTERNAL EXPANSION SLOTS FOR (4) INTERFACES — (RS-232, V.35, RS-449, X.21)
- POWERFUL HIGH-LEVEL USER FRIENDLY PROGRAMMING LANGUAGE
- X.25 LEVEL 2/3 ANALYSIS
- COMPREHENSIVE SNA DECODING AND ANALYSIS

APPLICATION

The LP COM TC-2000-02 Protocol Analyzer provides a combination of power and simplicity uniquely configured to satisfy the needs of both large and small communication data network centers in the development, installation, troubleshooting and performance monitoring of telecommunication services.

It is the first Protocol Analyzer to provide true and complete "dual port operation." Now you can monitor/emulate two independent interfaces at the same time, thus eliminating the need for a second instrument. There is no need to switch between the two lines under test when isolating problems; simply select the instruments split screen capability to capture those line interdependencies which are so difficult to detect and diagnose. Combining this unique feature with time stamping on a frame, packet or character basis, makes this capability a must for troubleshooting protocol converters, packet switches, network concentrators, etc.

The user friendly menus and integrated prompts allow even the inexperienced operator to master the instrument in a short period of time and be able to productively perform numerous tasks at the physical, data link and network protocol levels.

As a basic monitor, the TC-2000-02, by a simple keystroke, will automatically configure itself. It will determine the line's protocol, speed, etc., and instantly display the data along with any errors on its high resolution built-in and (optional) auxiliary color CRT. This powerful automatic detection capability further allows entry level technicians to perform numerous complex tasks quickly, easily, and accurately.

The flexibility designed within the TC's trap/trigger capability allows the user to select either 128 simplified traps and/or 16 combinational (or "super") traps, all with a wide selection of individual events and actions. For those users who need more complex trapping analysis or network simulation capability, a simplified but powerful programming technique utilizing test sequences (i.e. "scripts") plus an intelligent editor (i.e. "scripter") is available.

The TC-2000-02 supports all character and bit oriented protocols, up to 64Kbps. A wide variety of decoding formats is available to present data information at various levels and in a form convenient for supporting X.25, OSI, and SNA environments.

The TC-2000-02 has the industry's largest (standard) (1MB) RAM memory, plus a standard 10MB hard and 5-1/4" floppy disks.

A full remote capability over the DDD networks provides for the transfer of data, set-ups and user programs. The off line mode of operation allows the operator to view, process, and analyze the data at a later time by using a TC-2000 or any properly equipped compatible IBM PC.

A full ASCII keyboard with special protocol legends allows for convenient desk, bench, rack or even floor mounted operation.

When the TC-2000-02 is not being utilized as a Protocol test instrument, the full benefit of having an integral IBM PC compatible computer may be utilized for all of those administrative tasks normally required within a data center, plus the uploading/downloading of various files to/from various mainframes and mini computers.

Combine the TC's powerful computer with its unique open-ended software architecture and the potential of the machine is limited only by the users' imagination.

SPECIFICATION

Protocols Supported	X.25, HDLC, SDLC, (NRZ, NRZI), IPARS, Bisync, and most character asynchronous and synchronous protocols
Data Codes	ASCII, EBCDIC, HEX, BAUDOT, SBT, IPARS
Data Rates	50bps to 64Kbps full duplex user definable; separate TX/RX settings.
Interfaces Supported	RS-232/V.24, RS-449, V.35, X.21 and MIL-188 (any combination of up to four internally mounted)
Character Framing	5, 6, 7, or 8 information bits; for asynchronous lines select 1, 1.5 or 2 stop bits per character
Time Stamping, Absolute	Per character and per block basis in both on-line and off-line modes.
Parity	Odd, Even, None, Mark, Space
Error Checking	LRC, CRC-CCITT, CRC-16, CRC-12, or CRC-6
Bit/Block Error Triggers	63, 511, 2047 bit pseudo random sequences Rate Testing Consisting of characters and strings (with don't care bytes/bits), errors (parity, framing, BCC/FCS) interface lead transitions, or timing and counting values
Mass Storage Memory	1.0MByte RAM, 10MByte hard disk, plus 5-1/4" floppy disk
Display	7" diagonal, anti-glare character display
Display Mode	Single and Split Screen
Data Presentation	25 lines by 40 (or 25 lines by 80 in the split screen mode); line and time multiplex, frame, X.25 packet, SNA decoding and interface lead display; bright normal and half intensities, blinking, enhanced character selection, plus HEX.
Remote Capability	RS-232/V.24, transfer data set-ups and programs
Video Interface	B/W (composite) or color (RGB) output
Printer Output	Parallel
Dual Port Operation	Two independent receive/transmit interfaces
Other Features	■ Suppression/Enhancement of Display Characters ■ Code/Hex Conversion ■ Binary Character Representation ■ User Selectable Synch & Resynch Characters ■ Selectable Number of Trailing Pads ■ Alarm Indication ■ Multi-Page Freeze Mode with Paging Capability ■ Bit Shifting

Pricing and specifications subject to change without notice.



LP COM

TC-2000-04

SIGNALING/SUPERVISION/ADDRESSING

FEATURES

- 32 DIGIT RECEIVE DISPLAY
- ALL MF CODES INCLUDING KP, STP, ST2P, ST3P
- BATTERY AND GROUND
- SF
- STORAGE — SEVEN NUMBERS/32 DIGITS EACH
- E & M TYPES I-V
- LOOP START/GND START
- REVERSE BATTERY
- AUTOVON CODES

APPLICATION

The TC-2000-04 Signaling/Addressing/Supervision Test Set provides all the supervisory and address signaling functions needed to access a wide variety of transmission circuits. It has been designed to be extremely versatile, user friendly, and capitalizes on the TC's high resolution graphic display to present the easy to follow menu and prompts. Utilizing the power of Digital Signal Processing (DSP), the TC-2000-04 is truly a state-of-the-art versatile Signaling Test Set.

The Send and Receive functions of the test set are capable of independent operation for E&M, Loop, B&G, Reverse Battery and SF signaling modes. Measurement types include Pulses Per Second, % Break, First Pulse % Break, and Count Number of Pulses; these measurements can be made on pulse groups as well as pulse trains.

All MF codes including KP, ST, STP, ST2P, ST3P are provided in both send and receive modes making the test set useful for testing CAMA, TSPS and International Direct Distance Dial (IDDD) trunks.

Unique display indicators are utilized for monitoring Send and Receive "ON/OFF Hook" conditions as well as supervision indicators for Sleeve Ground, Ringing, and SF circuit idle/receive overload.

Provision is made for the operator to monitor the trunk under test via a built-in loudspeaker, or to communicate on the trunk being tested by using the MON.jack and a standard telephone butt-in (with 310 plug).

SPECIFICATIONS

SEND

Dialing	Keypad and memory provide no-wait dialing, plus storage and automatic repeat dialing of a number
Preset Speeds	8, 10, 12, and 20 PPS
Variable Speed	0.1 to 30.0 PPS, adjustable in 0.1 PPS increments
PPS Accuracy	±0.2 pulse
Preset %BK	49, 58, 60.5, 64, 73 percent break
Variable % BK	8.0 to 92.0% in 0.1% increments
%BK Accuracy	±0.2% (E & M and dry loop); ±0.5% (wet loop)
Interdigital Pause	250 to 999 milliseconds in 1msec increments; accuracy is ±2msec
Send Modes	Continuous pulsing, dial digits, repeat dialed number, continuous on-hook, continuous off-hook, store and forward, and dial from memory

RECEIVE

PPS Range	4.0 to 30.0 pulses per second
PPS Accuracy	±0.2 PPS
% BK Range	2.0 to 90.0% (at speeds up to 20 PPS); reading averaged over pulse group, or averaged over 12 pulses if receiving continuous pulses
% BK Accuracy	±0.2% (E & M, or Loop/B & G using Term); on Loop/B & G bridging; 25 to 75% BK up to 10 PPS, decreasing to 50% at 20 PPS
Interdigital Time	>300 milliseconds

INPUT IMPEDANCE

E&M Mode	22K bridging, 5.6K terminated line, or 3.3K terminated Drop networks
Loop Mode	Balanced 20K bridging, balanced 400 Ohm TERM, and internal electronic "A" relay

E & M

Interface Types	I, II, III, IV, and V, full duplex supervision status.
Receive	Wink Start (all types)

LOOP/B & G

Send Loop Resistance	0 to 6300 Ohm, in 100 Ohm increments
Send Leak Networks	Types A, B, C, D, and D1
"A" Relay Accuracy	(Electronic) $\pm 2\%$ Break at 60.5% BK, 12PPS, 1400 Ohm loop, and Leak Network A selected
Ground Start Function	Applies ground to Ring of Send jack for PBX tests
Reverse Battery	Supervision—Detect Far End status and control of Near End On/Off Hook status

SF

Internal Oscillator	2600Hz
Send Level	-20dBmO On hook, -8 dBmO Pulse
Test Level Point (TLP)	Line: -16 dBm Send, +7 dBm
Drop	+7 dBm Send, -16 dBm Receive
dB From Send TLP	Reduces Line or Drop levels Control from 0 to 12 dB
Supervision Indicators	Circuit idle and receive overload, wink start

MF/DTMF

SEND	Capability to send MF or DTMF signaling tones.
MONITOR	Capability to talk on and listen to the circuit under test.
RECEIVE	Capability to detect and decode MF/DTMF signaling tones.

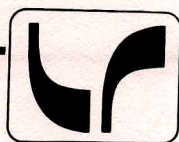
OUTPUT TONES

MF Signaling	Digits 0 through 9 KP, ST, STP, ST2P, ST3P; the TC-2000-04 automatically inserts a KP and ST code
DTMF Signaling	Digits 0 through 9, * & # (ABCD)

OUTPUT LEVEL

Signaling	-6dBmO (per tone)
TLP at LOOP SEND Jack (900 Ohm)	0dBm
TLP at SF SEND Jack (600 Ohm)	+7 to -5 dBm at DROP, -16 to -28 dBm at LINE
TLP at SF RCV Jack (600 Ohm)	+7 dBm at LINE, -16 dBm at DROP
Total Distortion (Signaling Tones)	Below -40 dBm
DTMF Tone Duration	Tone On: 60 msec Tone Off: 60 msec
DTMF Tone Frequency Accuracy	$\pm 1.0\%$
MF Tone Duration	KP code: 100 msec Other Digits 70 msec Tone Off: 70 msec
MF Tone Accuracy	$\pm 1.0\%$
Talk/Listen	Provides audible verification of call completion on Loop, B & G, Reverse Battery, and SF circuits

Pricing and specifications subject to change without notice.



LP COM

TC-2000-01

TIMS

FEATURES

- USER DEFINED AUTOMATIC TEST
 - SEQUENCES-MACRO COMMANDS
- LOGGING & DATE/TIME STAMPING OF RESULTS & TEST SET-UP
- POWERFUL ADMINISTRATION MODE
 - NOTEPAD
 - CALCULATOR
 - MS-DOS COMPATIBLE FILES
- SELF-CALIBRATING
- 4 & 2 WIRE OPERATION
- 20HZ TO 110KHZ OPERATION
- PLOTTING CAPABILITY
- ELIMINATES NEED FOR X-Y PLOTTER & STRIP CHART RECORDER
- DIGITAL SIGNAL PROCESSING
- REMEMBERS LAST TEST SET-UP
- FULL COMPLIANCE WITH BELL PUB-41009 AND IEEE-743

APPLICATION

The TC-2000-01 features complete multi-function TIMS capability including P/AR and Return Loss.

The TC-2000-01 acts as both transmitter and receiver of test signals for both four-wire and two-wire lines. Circuit measurement parameters include P/AR, Level Frequency, Envelope Delay, Noise (with and without tone), Phase and Amplitude Jitter, Intermod Distortion, all Transient Parameters, Return Loss plus Monitor and Dial/Hold capabilities. All measurement techniques conform to the Bell System requirements as detailed in PUB-41009 and the IEEE Specification 743. The TC-2000-01 is industry's first TIMS package to totally use the latest state-of-the-art Digital Signal Processing (DSP) technology. Performance has just entered a new dimension.

The truly unique capabilities of the TC-2000-01 are its' Automatic Test Sequences/Macro-Command/Plotting and Data Storage capabilities. Automatic test sequences may be user-defined and stored so that routine tests can be conveniently recalled, performed and automatically logged with minimal operator interaction.

The instrument's easy-to-use prompted menu-driven approach provides an ease of use unmatched in the industry today. Add to this a high resolution graphic display for all your plotting needs—plus user selected circuit limits. Training the entry level technician has just become a much easier and far less costly task.

SPECIFICATIONS

FOUR-WIRE (4-W) SPECIFICATIONS

TWO-WIRE (2-W) SPECIFICATIONS**

GENERAL TRANSMISSION/INTERFACE SPECIFICATIONS:

I/O Configuration	310 Jacks	310 Transmit Jack is Utilized
Measurement Type	Absolute and Test Level Point (TLP)	Absolute and Test Level Point (TLP)
TLP	-50 to +10dB	-50 to +10dB
Maximum DC Blocking	250V	250V
Measurement Mode	TERM/BRDG	TERM
Impedances	135, 600, 900, 1200 Ohm, TRMT and RCV Independent	600, 900 Ohm
Bridging Loss to 20kHz	<0.2dB	N/A
Return Loss (Receiver & Transmitter)	>20dB, 20Hz to 110Hz >30dB, 200Hz to 20kHz >30dB, 800Hz to 110kHz at 135 Ohm	N/A
Longitudinal Balance	>80dB at 60Hz, >70dB at 540Hz, 60dB up to 4kHz, decreasing 6dB per octave to 20KHz	>80dB at 60Hz, >70dB @ 540Hz 60dB up to 4kHz
Transhybrid Loss:	N/A	>30dB
Hold Circuits:	Two, each independent, each drawing 30ma at 48V	30ma at 48V

LEVEL/FREQUENCY MEASUREMENT SPECIFICATIONS:

TRANSMITTER FREQUENCY:

Range	20Hz to 5000 Hz (voice band) 200Hz to 110kHz (wide band)	300Hz to 5000Hz
Resolution	1Hz, 20 to 110kHz	1Hz, 300Hz to 5000Hz
Accuracy	±1Hz, 20Hz to 9999Hz ±10Hz, 10kHz to 110kHz	±1Hz, 300Hz to 5000Hz

TRANSMITTER SWEEP:

Mode	Single, repetitive, Gain Slope (404Hz, 1004Hz, 2804Hz), manual	Single, Repetitive, Gain Slope (404Hz, 1004Hz, 2804Hz), manual
Frequency Increments	1 Hz to 110kHz	1Hz to 5kHz
Increment Rate	0.3, 1.0, 3.0 Incr/Sec	0.3, 1.0, 3.0 Incr/Sec
SF Skip	Out/In (skips band from 2450Hz to 2750Hz)	Out/In (skips band from 2450Hz to 2750Hz)
Holding Tone	1004Hz ±0.1Hz	1004Hz ±0.1Hz

TRANSMITTER LEVEL:

Range	-50dBm to +10dBm +7dBm max in wideband mode +5dBm max at 135 Ohms	-50dBm to +5dBm
Resolution	0.1dB	0.1dB
Accuracy	±0.1dB (-30 to +10 dBm)@ 1004Hz ±0.2dB (-50 to -40 dBm)@ 1004Hz	±0.5dB @ 1004Hz
Flatness	±0.3dB, 20Hz to 100Hz ±0.1dB, 100Hz to 5kHz ±0.2dB, 5kHz to 50kHz ±0.3dB, 50kHz to 110kHz	±0.5dB, 300Hz to 5000Hz

**NOTE: For simultaneous transmit or receive operation, use 2-W mode; otherwise ALWAYS use 4-W mode for improved accuracy.

FOUR-WIRE (4-W) SPECIFICATIONS

TWO-WIRE (2-W) SPECIFICATIONS **

LEVEL/FREQUENCY SPECIFICATIONS CONTINUED:

Total Distortion:	>50dB below carrier (-40 to +10 dBm and 20Hz to 5kHz) >40dB below carrier (-40 to + 10dBm and 5kHz to 110kHz). Holding Tone >60dB (-30 to +10dBm)	>40dB below carrier (-40 to +5dBm and 300Hz to 5000Hz) Holding Tone >60dB
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RECEIVER FREQUENCY:

Range	20Hz to 5000Hz (voice band) 200Hz to 110kHz (wide band)	300Hz to 5000Hz
Resolution	1Hz, 20Hz to 10kHz 10Hz, 10kHz to 110kHz	1Hz, 300Hz to 5000Hz
Accuracy	±1Hz, 20Hz to 9999Hz ±10Hz, 10kHz to 110kHz	±1Hz, 300Hz to 5000Hz

RECEIVER LEVEL:

Range	-50dBm to +10dBm	-40 to +10 dBm (Dependent on Transmit Level and Transhybrid Loss Corrections)
Resolution	0.1dB	0.1dB
Accuracy	±0.1dB @ 1004Hz	±0.5dB, 300 to 5000Hz
Flatness	±0.3dB, 20Hz to 100Hz ±0.1dB, 100Hz to 5kHz ±0.2dB, 5kHz to 50kHz ±0.3dB, 50kHz to 100kHz	±0.5dB, 300 to 5000Hz
Filters	60Hz High Pass	N/A
Detector	Full Wave Average	Full Wave Average

RECEIVER PLOT:

Mode	On, Off	On, Off
Limits	3002, C1, C2, C4, Off	3002, C1, C2, C4, Off

NOISE-S/N SPECIFICATIONS

Detector	True RMS	True RMS
Response	Normal & Damped per IEEE Spec P743	Normal & Damped per IEEE Spec P743

MESSAGE CIRCUIT NOISE:

TRANSMITTER:

Mode	Quiet Termination	Quiet Termination
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RECEIVER

Range Metallic	10 to 90dBm	10 to 90dBm
Accuracy Metallic	±1dB	±1.5dB
Range to Ground	40 to 130dBm	N/A
Accuracy	±1.5dB	N/A
Resolution:	1dB	1dB
Filters	C-Message, 3kHz Flat, 15kHz Flat, Program, 50KB	C-Message, 3KHz Flat

NOISE WITH TONE:

TRANSMITTER

Mode	1004Hz Holding Tone (See L/F for Specs)	1004Hz Holding Tone (See L/F for Specs)
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RECEIVER

Range	10 to 90dBm	10 to 90dBm (Holding Tone @ -50dBm or limited by Transhybrid Loss)
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**NOTE: For simultaneous transmit or receive operation, use 2-W mode; otherwise ALWAYS use 4-W mode for improved accuracy.

FOUR-WIRE (4-W) SPECIFICATIONS

TWO-WIRE (2-W) SPECIFICATIONS **

NOISE S/N SPECIFICATIONS CONTINUED:

Accuracy	±1dB	±1.5dB
Resolution	1dB	1dB
Filters	C-Message, 3kHz Flat	C-Message, 3kHz Flat
Notch	Notch @ 1010; >50dB Rejection from 995 to 1025Hz	Notch @ 1010: >50dB Rejection from 995 to 1025Hz

SIGNAL-TO-NOISE:

TRANSMITTER

Mode	1004Hz Holding Tone (See L/F for Specs)	1004Hz Holding Tone (See L/F for Specs)
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RECEIVER:

Signal Level Range:	-40 to +10dBm	-40 to +10dBm (Depending on Transmit Level & Transhybrid Loss Corrections)
S/N Ratio Range:	10 to 50dB	10 to 45dB
Resolution	1dB	1dB
Accuracy	±1dB	±1dB
Filters	C-Message, 3kHz Flat, 1010Hz Notch	C-Message, 3kHz Flat, 1010Hz Notch

ENVELOPE DELAY SPECIFICATION

Operating Modes	Normal, Repeat	N/A
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TRANSMITTER:

Frequency Range	200Hz to 4000kHz
Level Range	-40 to +7dBm 0dBm max. @ 135 Ohm
Accuracy	See L/F for Specs
Modulation Frequency	83-1/3Hz, ±0.1%
Modulation Mode	50%, AM
Sweep	See L/F for Specs

RECEIVER:

Delay Range	-3000 to +9000 usec
Delay Accuracy	±10usec, 600Hz to 4000Hz, ±30usec, 200Hz to 600Hz
Resolution	1usec
Level Range	-40 to +7dBm
Level Accuracy	See L/F for Specs
Plot	See L/F for Specs

INTERMODULATION DISTORTION SPECIFICATION (See Note 1)

TRANSMITTER (4 Tone):

Frequencies	857, 863, 1372 and 1388Hz	857, 863, 1372, and 1388Hz
Level Range	-40dBm to 0dBm -6dBm max. @ 135 Ohm	-40dBm to -6dBm
Level Accuracy	±1dB	±2dB
Level Resolution	1dB increments	1dB increments
Distortion	≥70dB below individual tone level	>60dB below individual tone level

**NOTE: For simultaneous transmit or receive operation, use 2-W mode;
otherwise ALWAYS use 4-W mode for improved accuracy.

FOUR-WIRE (4-W) SPECIFICATIONS**TWO-WIRE (2-W) SPECIFICATIONS ******INTERMODULATION DISTORTION SPECIFICATION CONTINUED:****RECEIVER:**

Input Signal Range	-40dBm to 0dBm	-40dBm to 0dBm (Depending on Transmit Level and Transhybrid Loss Correction)
Measurement Range	10dB to 70dB with transmitter off. 10dB to 55dB with transmitter on.	10dB to 70dB (Depending on Transmit Level & Transhybrid Loss Correction)
Accuracy	±1dB	±1dB
Resolution	1dB	1dB
Filters	Second order products centered at 520Hz and 2240Hz; Third order products centered at 1900Hz	Second order products centered @ 520Hz and 2240Hz; Third order products at 1900Hz centered @ 1900Hz

Note 1: Intermodulation Distortion licensed under Hekimian Laboratories, Inc., U.S. Patent No. 3862380

P/AR SPECIFICATION**TRANSMITTER FREQUENCIES:**

Signal spectrum is a complex pulse train of 16 frequencies between 140Hz and 3890Hz designed to meet the requirements of IEEE Spec P743

Signal spectrum is a complex train of 16 frequencies between 140Hz and 3890Hz designed to meet the requirements of Bell PUB41009 and IEEE Spec P743

TRANSMITTER LEVEL:

Range	-40 to 0dBm -6dBm max. @ 135 Ohm	-40dBm to 0dBm
Accuracy	±1.0dB	0.1dB
Resolution	0.1dB	±1.0dB

RECEIVER P/AR UNITS:

P/AR Range	0 to 120 P/AR Units	0 to 120 P/AR Units
Accuracy	±2 P/AR Units (40-110 Units) ± 4P/AR Units (0 to 120 Units)	±2 P/AR Units (40-110 Units) ±4 P/AR Units (0-120 Units)
Resolution	1 P/AR Unit	1 P/AR Unit

RECEIVER LEVEL:

Range	-40dB to 0dBm	-40dB to 0dBm (Depending on Level and Transhybrid Loss Correction)
Accuracy	±0.2dB	1dB
Resolution	0.1dB	±1.0dB
Detectors	Ful wave rectified average, absolute peak, and RMS	Full wave rectified average, absolute peak, and RMS

PHASE-AMPLITUDE JITTER SPECIFICATION

TRANSMITTER:	1004Hz Holding Tone (See L/F for Specs)	1004Hz Holding Tone (See L/F for Specs)
RECEIVER:		
Frequency Range	990Hz to 1030Hz	990Hz to 1030Hz
Level Range	-40 to +10dBm	-40 to +10dBm (Depending on Transmit Level and Transhybrid Loss Correction)
Weighting	Bell Standard (20Hz-300Hz) Bell Standard + LF (4Hz-300Hz) Low Frequency (LF) (4Hz-20Hz)	Bell Standard (20Hz-300Hz) Bell Standard + LF (4Hz-300Hz) Low Frequency (LF) (4Hz-20Hz)

**NOTE: For simultaneous transmit or receive operation, use 2-W mode; otherwise ALWAYS use 4-W mode for improved accuracy.

FOUR-WIRE (4-W) SPECIFICATIONS

TWO-WIRE (2-W) SPECIFICATIONS **

PHASE-AMPLITUDE JITTER SPECIFICATION CONTINUED:

PHASE JITTER:

Measurement Range	0.0 degrees to 45.0 degrees peak to peak	0.0 degrees to 45.0 degrees peak to peak
Accuracy	± 0.2 degrees, $\pm 5\%$ of reading	± 0.3 degrees, $\pm 5\%$ of reading
Resolution	0.1 degree	0.1 degree

AMPLITUDE JITTER:

Measurement Range	0.0% to 45.0% peak to peak	0.0% to 45.0% peak to peak
Accuracy Range	$\pm 0.2\%$ peak to peak; $\pm 5\%$ of reading	$\pm 0.3\%$ peak to peak $\pm 5\%$ of reading
Resolution	0.1%	0.1%

RETURN LOSS SPECIFICATION

Measurement Modes	SRL HIGH, SRL LOW, ERL	SRL HIGH, SRL LOW, ERL
Transmit Level Range	-40 to 0dBm -40 to -6dBm @ 135 Ohm	-10 to -6dBm
Measurement Range	0 to 50dB	0 to 50dB
Accuracy	± 1 dB	± 2 dB
Resolution	± 1 dB	± 2 dB
4W Transhybrid Loss	-10 to +30dB	N/A
Compensation		
2W Ref Impedance	N/A	600 Ohm or 900 Ohm $\pm 1\%$ in series with 2.16uf $\pm 1\%$ capacitor

TRANSIENT SPECIFICATION

TRANSMITTER:	1004Hz Holding Tone (See L/F for Specs)	1004Hz Holding Tone (See L/F for Specs)
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RECEIVER:

RECEIVER LEVEL	-40 to +10dBm	-40 to +10dBm (Depending on Transmit Level & Transhybrid Loss Correction)
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RECEIVER FREQUENCIES	990Hz to 1030Hz	990 to 1030Hz
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Filter	C-Notch	C-Notch
Count Rate	7, 8 or 100 per second	7, 8 or 100 per second
Count Range	0 to 9999 counts	0 to 9999 counts
Timer	1 to 9999 minutes in 1 minute increments	1 to 9999 mins. in 1 min. increments
Hit/Dropout Guard	4msec, nominal	4msec, nominal
Interval Counting Hierarchy	Impulse noise counts are interlocked with hit and dropout occurrences in accordance with Bell System/IEEE P743 Specifications	Impulse noise counts are interlocked with hit and dropout occurrences in accordance with Bell System/IEEE P743 Specifications

THRESHOLDS:

Count without tone		
Impulse Noise Range	30 to 110dBm in 1dB steps	30 to 110dBm in 1dB steps
Normal Impulse Noise Range	30 to 110dBm in 1dB steps, limited to holding tone level -30dB/+15dB.	30 to 110dBm in 1dB steps, limited to holding tone level -30dB/+15dB.
Threshold Spread	2, 4, 6, 8 dB	2, 4, 6, 8 dB
Accuracy	± 1 dB	± 2 dB
Phase Hit Range	5 degrees to 45 degrees peak in 5 degree steps	5 deg. to 45 deg. peak in 5 deg. steps
Accuracy	± 0.5 degrees, $\pm 10.0\%$ of Threshold	± 0.5 degrees, $\pm 10.0\%$ of Threshold
Gain Hit Range	1 to 10dB in 1dB steps	1 to 10dB in 1dB steps
Accuracy	± 0.5 dB	± 1.0 dB
Dropout	>12db ± 1 dB decrease in level	>12dB ± 1 dB decrease in level

**NOTE: For simultaneous transmit or receive operation, use 2-W mode;
otherwise ALWAYS use 4-W mode for improved accuracy.

Pricing and specifications subject to change without notice.